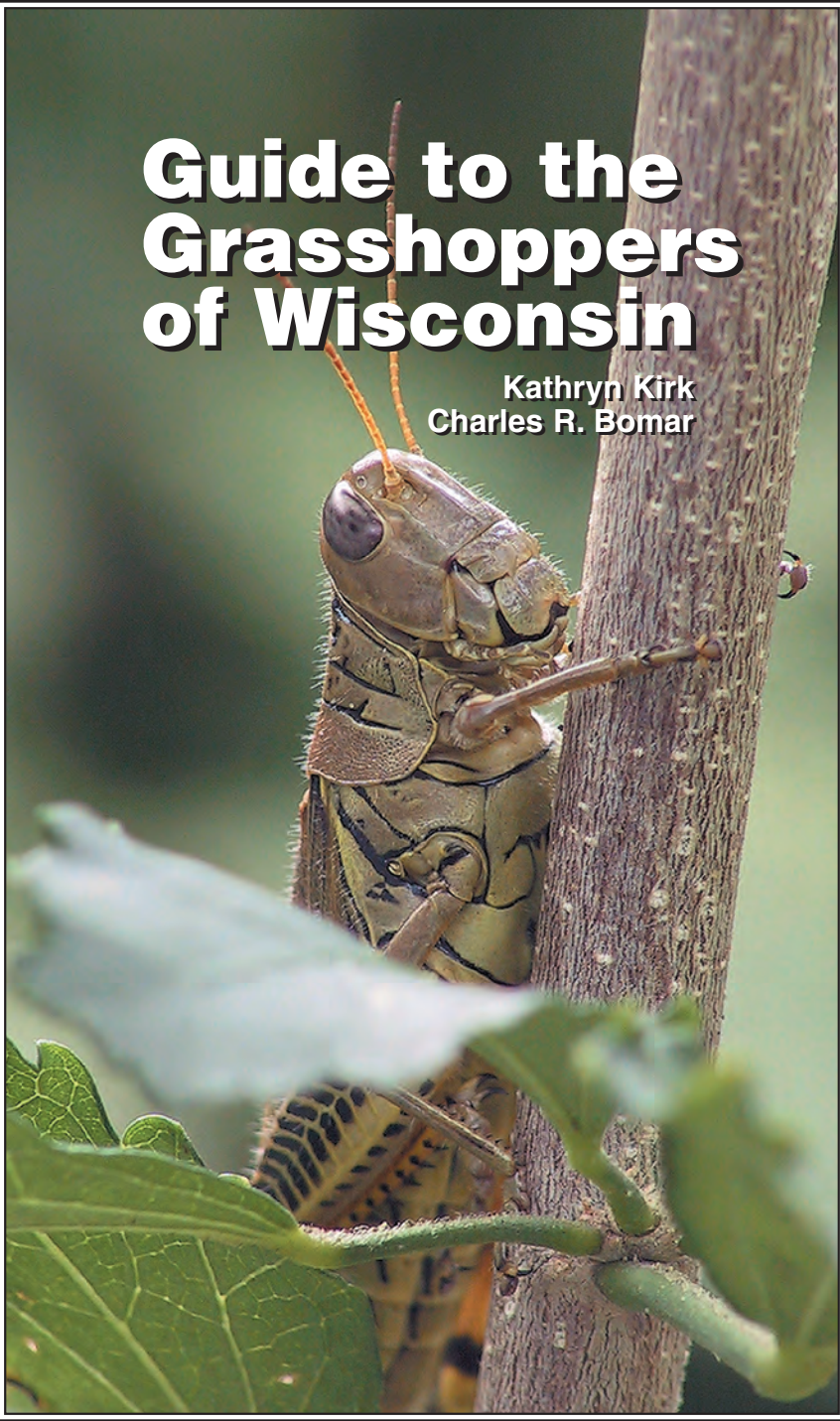


# Guide to the Grasshoppers of Wisconsin

Kathryn Kirk  
Charles R. Bomar



Front cover: *Melanoplus differentialis differentialis*.

Photo by Franziska Lang.

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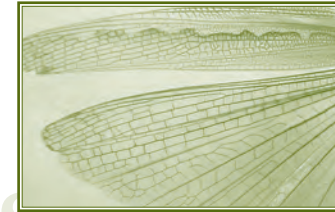
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# GRASSHOPPERS

## Guide to the Grasshoppers of Wisconsin

Kathryn Kirk and Charles R. Bomar

Edited by: Dreux J. Watermolen

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2005






KATHRYN KIRK

# GRASSHOPPERS

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***An Explanation  
of the Grasshopper***

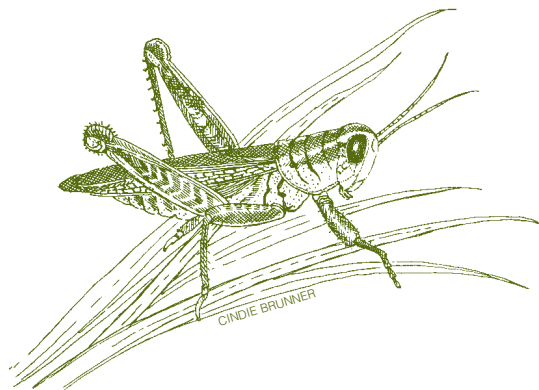
*The Grasshopper, the Grasshopper,*

*I will explain to you:*

*He is the Brownies' racehorse,*

*The fairies' Kangaroo.*


—Vachel Lindsay



# GRASSHOPPER INTRODUCTION



## **Purpose of This Guide**

 comprehensive survey of grasshoppers (Orthoptera: Acrididae) of Wisconsin has been long overdue. To date, only four taxonomic or ecological papers have been published on acridids from Wisconsin. Valek and Coppel (1972a,b) studied *Dendrotettix quercus* in central Wisconsin. More recently, Bomar (2001) and Bomar and Secrist (2002) explored the acridid communities in western Wisconsin prairies. In 1996, Harvey Ballard, Jr. developed an unpublished list of 55 Wisconsin Orthoptera based on specimens at the Insect Research Collection in the Entomology Department at the University of Wisconsin-Madison.

This guide provides the first comprehensive treatment of Wisconsin acridids and includes keys for identification of species, maps of known species distributions, descriptions of habitats occupied, and comments on taxonomy, life history, and ecology of the individual species. We also assess the conservation status of each species by listing its state rank (see Appendix C for the definition of status rankings).



## History of Grasshopper Surveys in Wisconsin

Collection of grasshoppers in Wisconsin can be described in terms of four time periods (Figure 1). The Exploratory Period encompasses the years 1881 to 1929. One of the first major contributions to the data was the study of J.D. Hood of the University of Illinois in Champaign-Urbana. At the same time that Hart and Gleason (1907) were exploring the sand areas of Illinois, Hood was conducting a similar study of the sand dunes and sand barrens along the Wisconsin River terrace at Lone Rock in Richland County, Wisconsin. Although no publication of this study has been found, various collections hold 26 different grasshopper species Hood collected in 1906 at Lone Rock including *Melanoplus flavidus*, *M. scudderi*, and *M. islandicus*. The Milwaukee Public Museum (MPM) sent an expedition to the western counties in 1910-1912 for zoological specimens, contributing 230 acridid specimens to the MPM collections.

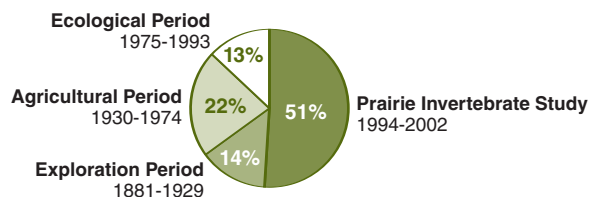


Figure 1. Collection period of specimens examined.

From 1930 to 1974, the Agricultural Period, interest in pest species prompted scattered collecting primarily in the 1930s and 1940s. W. McNeal collected *Dendrotettix* in oak forests in 1949. Incidental collecting produced data from the northern counties by individuals on summer vacation or participating in scout camps. During the latter years, student collections became popular with university biology classes in Wisconsin.

Student collections continued into the Ecological Period when teaching of biological diversity and ecological principles became standard biology curriculum. In addition, research studies from this period were particularly fruitful for our purposes. Wisconsin Department of Natural Resources (Wisconsin DNR) foresters studied gypsy moth parasitoids (1974 to 1977) in forests of the state. Orthoptera collected in malaise traps were stored in alcohol at the University of Wisconsin Insect Research Collection (IRC) and remained unexamined for over 20 years. In those vials we found 25 species including *Paratylotropidia brunneri* and *Chloaltis abdominalis*. A study of arachnids in Wisconsin prairies was conducted in 1986-1987. Stored in alcohol vials were 268 grasshopper specimens of 15 species, including *Orphulella pelidna*. Half of the total specimens that contributed to this report, however, were collected from 1994 to 2002. The Prairie Invertebrate Study, a multi-state effort begun in 1994 and administered through the Wisconsin DNR's Bureau of Integrated Science Services gave biologists the resources to inventory invertebrates on

prairies and savannas. In addition, Wisconsin DNR field biologists accelerated efforts to collect data on terrestrial invertebrates on state forest properties as a part of the biological inventories conducted by the DNR's Bureau of Endangered Resources.



## Wisconsin Geography and Natural Communities

Wisconsin lies at a juncture of the Eastern Deciduous Forest Ecoregion and the Prairie Peninsula, an eastward extension of the Great Plains Ecoregion. A band of overlap known as the Tension Zone spans Wisconsin from northwest to southeast, divides the state into the Mixed Conifer-Northern Hardwoods Province and the Prairie-Southern Forest Province, and provides a valuable reference for understanding Wisconsin biogeography. South of the band, there are fewer rainy days, higher summer temperatures and evaporation, and less average annual snowfall. Since the 1870s, botanists have observed that the range limits of many species fall within this band. Eventually, Curtis (1959) defined this zone based on the range limits of 182 plant species that enter the state from the North or from the South and West (Figure 2).

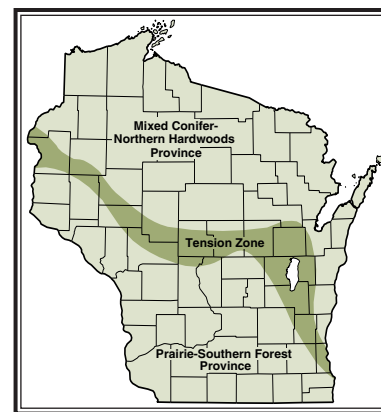


Figure 2. The vegetative tension zone (after Curtis 1959).

South and west of the Tension Zone the state is a mixture of farmland and deciduous woodland with remnants of prairie, oak opening, oak barrens on droughty soils, and oak woodland. Northern Wisconsin communities are dominated by conifers; largely forests of pine with maple and oak, beech on the east side of the state, hemlock and balsam fir plus tamarack and white cedar swamps, open bogs, northern sedge meadows and marshes, and abundant soft-water lakes. The Wisconsin, Black, St. Croix and Chippewa rivers and their tributaries drain two-thirds of the state into the Mississippi River on the western edge. The Fox River system including the Wolf River and numerous minor waterways drain the eastern portion into Lake Michigan. With Lake Superior to the north, Wisconsin waters contribute riverine forest, bluff lands, clay banks, and open beach and dune communities to the natural diversity of the state.

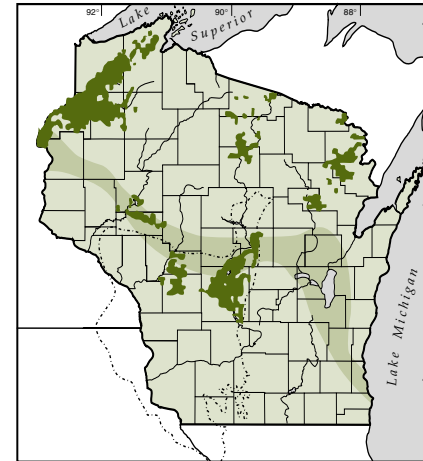


**Figure 3.** Geographic provinces in Wisconsin (after Martin 1965).

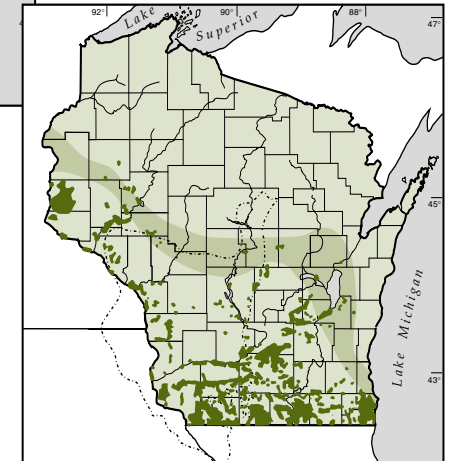
Wisconsin may be described, based on geology and glacial history, in terms of five regions or provinces (Figure 3). The northernmost province is the Lake Superior Lowland, an ancient rift valley at the western edge of Lake Superior bounded by dramatic red clay bluffs. The shoreline includes 22 islands with sandstone bluffs and sand or gravel beaches. The lowlands support open bogs, black spruce swamps, muskeg, and interdunal wetlands (NHI 2002). In this province, boreal forest extends into Wisconsin adding white spruce, balsam fir, and white cedar forests to the mix of red and white pine, hemlock, birch, and sugar maple of the northern mesic forest, the dominant community type of the Northern Highland province. This area is part of a vast upland “shield” of Precambrian bedrock sloping southward from Labrador and Hudson Bay and characterized in Wisconsin by flat plains and hills of glacial drift. Significant sand deposits in the western part of the province support jack pine forest and pine barrens (“the Northwest Sands”), with smaller amounts of similar habitat in the eastern and the north central portions of the province (Figure 4).

The Central Plain is a crescent of Cambrian sandstone below the northern forests and is widest in the middle of the state (“the Central Sands”), where pine and oak barrens are interspersed with marshlands over a glacial lakebed. Escarpments, rocky hills, buttes, and mesas dot the landscape where erosion resistant rock caps the sandstone. This is a transition zone between forest and grassland regions. Here, jack pine, bur, black, and Hill’s oak begin to have a greater presence.

The topography of the Eastern Ridges and Lowlands is a study in glacial history. The retreating ice left drifts of sand, gravel, and fragments of older rock carried from the North over dolomitic limestone bedrock. Drumlin and eskar mounds strafe the landscape and morainal hills mark the stuttering progress of the glaciers’ retreat. Much of the moraine area is now farmland, but oak woodland and degraded oak savannas are present, and remnant dry prairie may be found on south and west-facing hillsides.



**Figure 4.** Original pine barrens habitat in Wisconsin (from Cochrane and Iltis 2000).



**Figure 5.** Original tallgrass prairie habitat in Wisconsin (from Cochrane and Iltis 2000).

Some areas are dotted with “kettles”, formed from melted ice blocks that hold wet prairies, fens, sedge meadows, or conifer swamps. The bedrock is exposed in the Door County peninsula as the rocky cliffs of the Niagara Escarpment above the Lake Michigan shore. Dune and beach communities border the lake, and ridges and swales formed from old Lake Michigan shorelines support conifer swamps, marshes, and sedge meadows with disjunct boreal forest, white cedar, and northern mesic forest on the high ground.

On the western side of the state is the Western Uplands province, the major portion of which is the Driftless Area. This area is exceptional for having been totally surrounded by glaciers but never scraped by the ice or covered in glacial drift. The area abounds in rocky crags, columns, standing rocks, towers, sinkholes, and caves. Residual soils from the sandstone bluffs above the Mississippi River were transported by the wind into pockets of dunes in the river valleys (Martin 1965). Loess deposition contributed to the silt loam soils along the western counties, where many of the original tallgrass prairies were present in openings within the oak forests (Figure 5).

The Driftless Area lacks standing water but is braided by rivers and streams often running in deep valleys called coulees. Today, prairies are most often found on west and south-facing hillsides where conditions mimic the dry, exposed habitats of the West. Many of Wisconsin’s grasslands are in the process of being recovered from decades of fire prevention and the spread of red cedar and other persistent woody vegetation.





## Grasshopper Habitats

Grasshoppers are generally associated with grasslands, but also occur in barrens, marshes, bogs, interdunal wetlands, and forests, and along cobble and sand beaches. This section includes photographs of some representative grasshopper habitats in Wisconsin.



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### RESTORED PRAIRIE

*Sauk County*



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### OAK OPENING

UW Arboretum

*Dane County*



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### HILL PRAIRIE

*Crawford County*



### OAK SAVANNA

*Iowa County*

MIKE MOSSMAN



ERIC EPSTEIN

### BASALT GLADE

Interstate State Park

*Polk County*



ERIC EPSTEIN

### SANDSTONE CLIFF

Lone Rock

*Richland County*





ERIC EPSTEIN

### **PINE BARRENS**

Stockton Island  
*Ashland County*

### **SAND BARRENS**

Blue River  
State Natural Area  
*Grant County*

### **SAND BLOWOUT**

Millston  
*Jackson County*



THOMAS MEYER



ERIC EPSTEIN

### **MARSH**

*Oconto County*



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### **OPEN BOG**

Chippewa County  
Forest  
*Chippewa County*

### **WIREGRASS SEDGE MEADOW**

Black River  
State Forest  
*Jackson County*



ERIC EPSTEIN





DNR PHOTO ARCHIVES

**SANDBAR** Wisconsin River *Columbia County*



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**COBBLE BEACH** Lake Michigan

**LAKE MICHIGAN DUNE**  
Whitefish Dunes State Park  
*Door County*



ERIC EPSTEIN

**INTERDUNAL WETLAND**  
Stockton Island  
*Ashland County*



ERIC EPSTEIN

**DRY-MESIC FOREST**  
Chambers Island  
*Door County*



ERIC EPSTEIN

**OLD FIELD**  
*Door County*



KATHRYN KIRK



## Grasshopper Biology and Life History

**S**hort horned grasshoppers (Orthoptera: Acrididae) represent a very diverse array of species found occupying numerous habitats around the world. Over 600 species exist in the United States and Canada (Arnett 2000). Grasshoppers are generally associated with grasslands, but also occur in wetlands, marshes, and forests. Grasshoppers are univoltine, having one generation per year. Grasshoppers have an incomplete metamorphosis in which three life stages occur: egg, nymph, and adult. The length of each of these stages varies greatly, depending upon time of year and stage of emergence. From the egg emerges a small first instar nymph. This nymph then passes through multiple instars, with the final instar being the adult stage. Most grasshoppers have 4-6 instars. Morphological features that vary with instar include length of wings, number of antennal segments, and presence of reproductive genitalia in the adults (Capinera and Sechrist 1982).

Adult grasshoppers are found from June to October with most species present in late summer. Males use sound, color, and behavior to attract females. Stridulation, drawing the hind leg across a ridged area of the wing to create sound, is used by some species in tall grasses. Wing-crackling (crepitation), hind leg signaling, and flashes of colorful hind wings are used by banded-winged grasshoppers in open areas. The Melanoplinae, with many similar species, use neither of these devices. Rather, the male jumps a female he chances to encounter and begins a species-specific behavior of hind leg shaking. Melanoplinae show little diversity of gross morphology but the genitalia of both sexes are specific for each species.

After copulation the female forms an egg pod by combining a frothy excretion, local soil, and the eggs. The female deposits this pod by burying it in the soil (see photograph, page 102), plant roots, or rotten logs, or laying it directly on the surface of the soil. The eggs go through an obligatory diapause before hatching in the spring. Pods vary in egg number depending on the species; from 3-5 eggs per pod in *Ageneotettix deorum* to nearly 200 eggs per pod in *Melanoplus differentialis differentialis* (Pfadt 1994). Females will deposit multiple egg pods during the adult stage. Most species overwinter as eggs. Six species found in Wisconsin (*Eritettix simplex*, *Arphia conspersa*, *A. sulphurea*, *Chortophaga viridifasciata*, *Pardalophora apiculata* and *P. haldemani*), however, are exceptions. These species overwinter as late instars and complete development in the spring. Adults are present typically until mid-June.

Grasshoppers represent an economically important insect in many parts of the United States given their destructive nature in agricultural and rangeland settings. Many western states often report grasshopper densities in excess of 15 grasshoppers per square meter. These population outbreaks often require use of a chemical or biological agent to control the population. While large outbreaks have not been recorded recently in Wisconsin, there were numerous reports of crop damage by grasshoppers in the mid-1930s. Actual documented records of such events, however, are scarce. Fortunately, such levels of damage no longer occur in Wisconsin.



DICK DUBIELZIG



## The Wisconsin Grasshopper Fauna

**T**he inspiration for this project began with the U.S. Fish and Wildlife Service's Partnership for Wildlife survey of prairie invertebrates. We began collecting specimens in 1996 on state-owned forest, park, and wildlife properties and on managed prairie remnants on hillsides, bluff tops, and railroad rights-of-way. The majority of specimens collected during the study were taken from grasslands: hill prairie (goat prairie), pine/oak barrens, sand prairie, open oak woodland, and jack pine forest, with attention given to roadsides, sandblows, and gravel pits. Wetland sites were poorly represented in our efforts, as were beach and sand dune communities, boreal forest, northern mesic forest, and southern lowland forest.

From 1999 to 2002, 18 entomological collections were surveyed. The majority of grasshopper specimens were found at the University of Wisconsin Insect Research Collection and the Milwaukee Public Museum. Teaching and student collections at the University of Wisconsin campuses of Eau Claire, Green Bay, La Crosse, Oshkosh, Platteville, River Falls, Stevens Point, Stout, Superior, and Whitewater, University of Minnesota-Duluth, Winona State University, and the UW Arboretum in Madison were surveyed for acridid specimens. We examined specimens from the Leopold Foundation in Sauk County and Lawrence University in Appleton. Wisconsin specimens also were discovered in the collections of the Field Museum of Natural History, Illinois Natural History Survey, University of Minnesota, University of Michigan, and the Academy of Natural Sciences of Philadelphia.



In addition, we examined specimens collected during the period of the study by other prairie invertebrate researchers, Wisconsin DNR wildlife managers, and conservation biologists at the Wisconsin DNR Bureau of Endangered Resources. Specimens were identified using keys in Otte (1981, 1984) and Vickery and Kevan (1985), with help from Scudder (1897), Brooks' (1958) drawings of the *Melanoplus* spp. genitalia, and Hubbell's (1960) and Song's (2004) treatments of *Schistocerca* spp.

We have identified 70 species of Acrididae from Wisconsin, none of which are endemic to the state. We also believe one additional species (not included in the list below) is adventive. *Romalea microptera* (not a true short horned grasshopper, Orthoptera: Romaleidae) was collected June 23, 1973, on the bluffs above the Mississippi River in the south-western corner of the state and one was also collected in a garden in Madison on July 20, 1965. The first specimen was likely a migrant from Mississippi River barge traffic; the second specimen is less understood, but perhaps represents an escaped specimen from a biology class.

Ten other species were collected at only one site and may now be extirpated from the state. These are *Pardalophora phoenicoptera*, *Hippiscus ocelote*, *Metaleptea brevicornis*, *Schistocerca alutacea*, *S. americana*, *S. damnifica*, *Paratylotropidia brunneri*, *Encoptolophus costalis*, *Hesperotettix speciosus*, and *Melanoplus rusticus obovatipennis*. Only one species on this list, *H. speciosus*, has been collected recently in Wisconsin; the others have not been collected in at least 25 years. Further survey work needs to be done to clarify the status of these species in Wisconsin.

It is possible that another sixteen species may be found in the state, based on collections in neighboring states in habitat similar to that found in Wisconsin. Nine of these species (*Melanoplus packardii*, *M. occidentalis*, *Hypochlora alba*, *Campylacantha olivacea*, *Amphitornus coloradus*, *Mermiria picta*, *Boopedon auriventris*, *Metator pardalinus*, and *Xanthippus corallipes*) are known from the grasslands to the West. Two species are preferential to wetlands or wet grassland, and include *Stethophyma celata* from Minnesota and Illinois and *Paroxya hoosieri* from Michigan and Indiana. Five species are associated with northern woodlands of Michigan and Minnesota and include *Melanoplus eurycerus*, *M. gracilis*, *M. huroni*, *Appalachia arcana* (endemic to Michigan), and *Booneacris variegata*. To confirm these species in Wisconsin, formal surveys will need to be conducted in appropriate habitats. The woodland and wetland habitats, for example, have not been surveyed in any manner for grasshoppers. To account for their potential presence in Wisconsin, we incorporated most of these species into the taxonomic keys included in this guide.



GIFF BEATON

## GRASSHOPPER IDENTIFICATION KEYS



GIFF BEATON

ERIC EPSTEIN